Wallrich Bridge
Carrying Township Highway 276B
Over the North Fork of the
Vermilion River
Cullom Vicinity
Sullivan Township
Livingston County
Illinois

HAER No. IL-132

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
National Park Service
Department of the Interior
Denver, Colorado 80225-0287

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HISTORIC AMERICAN ENGINEERING RECORD

WALLRICH BRIDGE

HAER No. IL-132

I. INTRODUCTION

Present Location:	Livingston County, Illinois Spanning the North Fork of the Vermilion River, south of Cullom, 2.7 miles, west 1.0 mile; north of Chatsworth, 5.5 miles
USGS Quadrangle:	Chatsworth North Latitude 40°-50.26'; Longitude 88°-16.80' UTM 16.392080.4521320
Inventory Data:	Township Highway 276B Wallrich Bridge Illinois Structure No. 053-3404 SW,SE Quarters, Section 2,3, T27N, R8E Sullivan(N), Charlotte(S) Township line. Livingston County
Date of Construction:	1905, County Board of Supervisor files
Owner, Custodian:	Sullivan Township, County maintenance
Present Use:	Vehicular bridge programmed for replacement
Significance:	This three-span bridge, 172'-0" long, with a center bow span of 123'-0" is one of the few bridges of this type remaining in Illinois. Bowstring bridges were infrequently used on secondary roads before about 1870, preceding the near universal acceptance of rectangular metal truss designs.
Historian:	John B. Nolan, S.E. 21 June 1996

II. HISTORY

The North Fork of Vermilion River drains the prairie basin of east central Illinois, flowing northeasterly into the Illinois River at LaSalle. The surrounding flat plain, formerly covered with glacial lakes, was a swampy area until a steam dredge, working downstream, opened the present channel in 1904 to improve the drainage of low areas of Ford and eastern Livingston counties. The area is extensively cultivated. The North Fork, a hundred feet wide at this location, flows between steep, sparsely vegetated banks about twenty feet high.[1]

County histories record the settlement of the adjacent townships in the spring of 1858, a date over twenty years later than many other communities in the region, a delay largely due to the undesirability of wetlands and the reluctance of early settlers to locate in areas without trees. Trails through the swamps were often impassable until the first public road in the county, the present principal route connecting Cullom and Chatsworth, was laid out about 1860 by Patrick Monahan, one of the early settlers.[2]

An 1893 plat book shows a Wallrich owning 12 acres north of the river at this location. A 1910 ownership atlas shows T.J. Wallricks [sic] as the owner of 115.85 acres south of the river, occupying both sides of the road at the bridge site. "Wallrick" is the local pronunciation for Wallrich. The farm has remained in the Wallrich family to this date; the home of Ray Wallrich is located southwest of the bridge.[3]

The widening of the river channel necessitated the replacement of several bridges. The sole reference to the construction of this bridge is an entry found in the County Supervisor's handwritten report of 2 September 1905:[4]

> "The undersigned commissioners of the towns of Charlotte and Sullivan in said county would respectfully represent that a bridge and approaches is being built on the Vermilion River between sections 2 and 3 in Charlotte Township to cross Vermilion River into Sullivan Township.
>
> > "In which said work the towns of Charlotte and Sullivan are wholly responsible that the total cost of building said bridge will be $2350 Dollars which sum will be more than twenty cents on the one hundred dollars on the latest assessment roll of said town and that the levy of the road and bridge tax for the two preceding years in said town was in each year was for the full amount of forty cents on each one hundred dollars allowed by law for the commissioners to raise the major part of what is needed for the ordinary repair of roads and bridges."
>
> Among the commissioners signing for Charlotte Township was Thomas J. Wallrichs [sic].

By local tradition the bridge had been used earlier in Kankakee County before being moved to this location. No supporting records have been found, but it is not an unreasonable assumption to date the original structure erection in the 1860s or 1870s. "Mr. Lowell Flessner, a retired drainage contractor of Chatsworth, Illinois, has related that his father helped erect the Wallrich Bridge in 1905....the bridge was brought by rail to the siding at Charlotte and transported in pieces by horse and wagon to the site where it was erected by local labor."[5]

Early township maps and plat books seldom identify bridges over streams. Mendenhall's 1902 map of Through Bicycle Routes in Illinois includes the road between Cullom and Chatsworth, possibly an indication that an earlier bridge was at this location. The 1917 map showing marked routes identify the east-west road through Chatsworth as the Corn Belt Route, the forerunner of U.S. 24.[6]

Although the road is not heavily used, it serves as a farm-to-market connector, school bus and postal route between Illinois Route 116 and U.S. Route 24, both primary east-west arteries. The county highway surface is narrow and of low quality bituminous but adequately smooth.

III. THE BRIDGE

A. The Bridge Type

The main span of the Wallrich bridge is a simple span through bowstring truss, a type of truss described by Squire Whipple, in his essay on Bridge Building, published at Utica, N.Y., in 1847. The Bowstring Truss shape is highly economical in material as the stresses in all members are nearly uniform.[7]

In the 1860s Zenas King patented a tubular arch with a square cross section. The King Iron Bridge and Manufacturing Company erected many bowstring bridges using rolled or fabricated rectangular shapes for the arch chord. In 1867, William Rezner, a physician of Cleveland, Ohio, created the "Patented Oval Wrought Iron Tubular Arch Bridge" using rolled half-round plates bolted together, and in 1870 and 1873 David Hammond and Michael and Job Adler patented a "Column plate and Channel Arch Bridge". The arched chord was described as made of plates bent into a quarter circle with flanges down each side for riveting four plates together into a hollow tube or column.. The oval shape of the tube was intended to increase the stiffness. Rezner soon returned to private medical practice, but his ideas were adopted by the Wrought Iron Bridge Company.[8]

In a bowstring arch bridge the lower chords and diagonals carry tensile stresses. The lack of lateral stability in the arched compression top chord is the weakest part of the design. Lateral stability is aided by external sway brace frames, overhead lateral framing and cross-framing. This bridge type was generally phased out by 1900 in midwestern states, being replaced by Pratt and Warren trusses, which were rational to design, easier to ship and erect, and had the strength and stability to carry larger loads.[9]

By the turn of the century, national quality standards were being developed, and many smaller bridge companies ceased operations or merged into larger companies, principally the American Bridge Company. A report of the first Illinois Road Commission in 1906 urged uniformity in design and the development of experienced contractors.[10]

Wallrich Bridge is one of the few bowstring arch trusses remaining in the state. Effective maintenance and light traffic have enabled this anachronism of early bridge engineering to survive for over 91 years at this location, perhaps as long as 130 years if total life assumptions are correct.

B. The Manufacturer

Although the fabricator and erector of this truss has not been located in the available records, a number of details are similar to the photographs and brief descriptions of two early bowstring arches built by the Wrought Iron Bridge Company of Canton, Ohio; the Paw Paw Creek Bridge in Miami County, Indiana, built in 1874 and the 1877 Riverside Cemetery Bridge in Mahoning County, Ohio.[11]

WIBC was a prolific early bridge builder of many types. Known truss bridges built by this company in Illinois include the Big Bureau Creek Bridge at Tiskilwa, 1899, now replaced; Renwick Road Bridge near Plainfield, 1912 or earlier; and the Muirheld Bridge near Blue Mound, 1893.[12]

Organized in 1864 by David Hammond, a Stark County carpenter-turned-bridge-builder, the company was incorporated in 1871. It became one of two leading bridge companies which gave Ohio a national bridge building reputation. Despite the claim of Indiana commissioners that Hammond was no engineer, he was a good promoter, and his firm owned a number of patents. The company built more bridges in Indiana than any other company.[13]

Early bridge companies, including WIBC, distributed catalogs, and agents in the field secured bridge contracts from towns and highway commissioners in their region. Catalogs familiarized the town fathers and bridge committees with the product line. Hence the term "catalog bridges," because they could be ordered "by-the-foot" directly from the catalog, shipped to the site and erected by local crews under the supervision of company agents.[14]

Formed in the dynamic period of the industry's history, Wrought Iron adjusted as bridge building progressed from a craft to an industry. Challenged by the shift of the iron industry to steel, the emergence of professional bridge engineering, and the evolution of business methods, it survived to be absorbed into the American Bridge Company in 1900, as were half of the nation's fabricating companies still in existence.[15]

C. Structure Description

For a schematic sketch of the Wallrich bowstring truss, prepared by Boyer Engineering, Ltd., see pages 14 and 15.[16]

Three Spans, total length 172'-0".

1. South approach span, approximately 24'-6" long, single span, timber deck on five I-Beams 9"x4" at 2'-6" centers and edge channels 9"x2 1/2". Diaphragms, 4" I-bm, at third points. Deck and railing as on main span, bent stanchions for rail support at quarter points.

2. Main span, through bowstring truss. Length 123'-0", six (6) panels, end panels at 19'-6", four interior panels at 21'-0". Tubular arches, horizontal distance center to center, 15'-4"; clear roadway width, 14'-10 1/2"; clear height above the roadway 11'-9". From U3L3, a 16'-0" center to center ordinate, the arch tube bow closely follows the parabolic equation $y=.004(x^2)$, (excepting U0L0 bearing which is 15.13' instead of 16'-0"). Truss details are generally symmetrical about the U3L3 centerline. Panel distances are measured longitudinally between floor beams; all bracing frames are 7" south (towards L0) of adjacent floor beams.

   Compression arch tubes, L0-U1-U2-U3-U4-U5-L6:
   Four quarter-circle plates, 1/4" thick, bent to 4" radius, with 2" outstanding flanges for riveting; two channel, 3"x1 1/4"x3/16", spacers between 90° bent plates on top and bottom, forming an horizontally widened circular cross-section; A horizontal plate, 15 1/2"x 3/16", bisects the tube into upper and lower halves. Assembled with round headed stitch rivets at approximate 10" centers, about 60% of which have been replaced with bolts. Arch segments are field connected with staggered joints about the U1, U2, U3 panel points. See cross-section of arch chord on page 15.

   Lower chord, L0L6:
   Two 6"x5/8" vertical plates, 1" clear. Ends of vertical and diagonal truss web rods are flattened to 1" and bolted between lower chord plates with a single bolt.

   Vertical Members:
   U1L1 one rod 1 1/2" rd., flattened loop end bottom, passes through top of arch tube, bevel shim and square nut.
   External triangular sway bracing frames;
   U1L1: approx ord ht 8'10", lower width 1'9".
   U2L2: " " " 14' 3", " " 2'1".
   U3L3: " " " 15'11", " " 2'8".

   . Frame edges, two angles 1 1/2"x1 1/2"x3/16"; Double lacing, 1 1/4"x1/4" at 1'-3" centers.

- Transverse lower support beams, WF 6"x3", rest on top of lower chords, independent of and 7" to south of floor beams at panel points L1, L2, L3, etc.
- Welded extensions for frame connections: top, 1 1/2" rd. rod, through arch tube with bevel shim, 1"x3" sq. nuts; lower outside connection, welded 1" rd. rod bent vertical, 12" clear and through extended support beam; lower inside connection, inner edge angle legs of frame extended and attached to lower chord plates.

U1.5L1.5, U2.5L2.5, cruciform rods, 3" out to out, 1/2" thick, flattened on lower end for single bolt through lower chord; 1 1/2" welded threaded rod extension through arch tube and bevel shim, 1"x3" sq. nuts.

Diagonals:
Single rods, 1" dia., ends threaded (without upset); lower ends looped around 1" dia. bolts through lower chord plates near panel points; upper ends pass through arch tube with bevel shims, hex nuts.

Top lateral bracing:
U2U2, fabricated laced strut, 1'-11" back to back, paired edge angles 1 1/2"x1 1/2" back to back, 1 1/4"x1/4" bar lacing, brackets to top and bottom of arch tube. Metal sign attached to strut, with cutout characters:

CLEARANCE
12 FT 2 IN

U2.5U2.5, fabricated laced strut, estimated 3'-3" deep, details similar to U2U2. Upper edge bracketed to top of arch tube, lower edge clamped to cruciform rod.
U3U3, originally a laced strut similar to above. After the original assembly was impacted the damaged strut was replaced in 1982 with an I-beam attached to the arch tube top. Knee braces were also added.[17]
Panel cross bracing, U2U3, U2.5U2.5, rods, approximately 7/8" dia., ends threaded for tightening bracing. Attachment brackets to top of arch tube.

Bottom lateral cross bracing:
L0L1, L1L2, L2L3, rods approximately 7/8" dia., loop ends bent and bolted near ends of floor beam webs with single bolt connecting opposite loops, sleeve nuts provided for adjustment.

Floor Beams:

L0L0, end floor beam, WF 6"x3 1/2", supported on 4 interior columns, WF 5"x3", and end stub columns on caisson tops, all new construction. (See pier description, below.)

L1L1, L2L2, L3L3, riveted hauncbed plate girder, flange angles 3"x2"; 11" back-to-back on ends, approximately 2'0" at center; channel 9"x2" on upper flange, legs down, may have been added later. Floor beam ends rest on lower chord plates.

Stringers:

Six 7"WF3 1/2" and two edge channels; transverse spacer channel 9"x2", legs down, welded to bottom flanges of stringers; midspan between floor beams, at, but not attached to, intermediate vertical rods.

Deck:

3"x10" (nominal) transverse creosoted timber, 3"x12" (nominal) longitudinal edger. Present deck installed in 1978.

End bearings:

Cast block socket shoes at arch ends, 14"x18" footprint, lower chord bars extend through back side, pin 2-1/2" dia. Roller nest expansion at south bearings.

Rivets:

1/2" dia. main members, round head.

Rail:

Continuous channels 3"x1 1/2", toes to roadway, 18" and 32" above the floor. Connected to arch center, clamped to vertical rods and bracketed to sway frames.

. Rail on approaches is supported by 4"x2 1/2" posts, cantilever brackets from edge channels, 8'-0" spacing.

3. North Approach Span:
Details are similar to those of Span 1, described above.

4. Substructure:

Piers 1 and 2, supporting the truss bearings, are tube caissons at the water's edge, 1/4" steel, 3'0" dia. Top plates are 1/4"x3'-6" dia. Stringers of approach and truss spans are supported by four intermediate I-beam 5"x3" columns, framed between brackets on the caisson, and similar stub beam posts from the caisson top. Additional welded diagonal bracing between the caisson completes the pier assembly.

Present abutments have stub columns supporting an end floor beam, and steel plate backwalls. These abutments have been reconstructed but probably in a manner similar to the original.

D. Present Condition And Modification

At the time of assumed re-erection at the present site, the Wallrich Bridge was probably remodeled, perhaps extensively. The brace frame support method, which is independent of the floor beams, could have been added at that time.

Many of the 7" main span stringers are embossed with the mark "Cambria". The Cambria Iron Company of Johnstown, (Cambria County), Pennsylvania, a steel company which survived repeated and severe flood damage after the 1889 disaster, was absorbed into Bethlehem Steel after World War I. Approach span stringers are embossed "Carnegie", a supplier which rolled beams from 1896, merged into U.S. Steel in 1901 but continued to mark beams into the 1930s.[18]

Maintenance needs on Wallrich Bridge through the years have been excessive. An estimated 60% of missing or defective rivets in the arch chord have been replaced with bolts. Overhead bracing assemblies, sway frames and connections are lightly designed and show repeated rewelding, component replacement and innovative repairs by maintenance forces. However, earlier structural concepts and integrity do not appear to have been compromised.

Repairs in 1976 included the straightening or reinforcement with steel splice plates of: (1) a diagonal in the north panel of the west truss; (2) all (five) lateral sway bracings along the top chords; (3) handrail; (4) loose diagonals; (5) others as revealed; also, (6) replacement of top chord rivets; (7) replacement of timber deck; and, (8) cleaning and painting. Cost with extras, $17,723.05.[19]

The timber deck is sound and the painting in good condition. There is evidence of local areas of strengthening but no modification of the bowstring trusses. No distress areas were noted in the members during the collection of descriptive data.

The bridge is posted for five tons and one lane of traffic.

The Wallrich Bridge is a unique and structurally significant bridge. Without nearby trees or a brushy river bank to obstruct the view, the graceful arches rising unexpectedly above the prairie can be seen from a great distance.

E. Ownership and Future

The Wallrich Bridge is owned and maintained by Sullivan and Charlotte Townships and the Livingston County Highway Department. Due to the restricted width and low load carrying capacity, the county has scheduled replacement of this structure. Although the bridge, because of age, fabrication details and location, is of more than usual structural interest, its alignment and size make preservation for recreational purposes or historic record an unlikely alternative.[20]

IV. END NOTES

[1]Christopher J. Schuberth, A View of the Past, An Introduction to Illinois Geology. (Springfield: Illinois State Museum, 1986), pp. 139ff; David R. Winters, P.E., conversation, May 31, 1996; "Wallrich Bridge", Section 106 Preliminary Case Report and Programmatic 4(f) Evaluation. (Springfield: Illinois Department of Transportation Bureau of Design and Location files, 1996),p. 2.

[2]Bateman and Selby, Historical Encyclopedia of Illinois and History of Livingston County, Illinois, Vol. 2. (Chicago: Munsell Publishing Co., 1909) pp. 760ff.

[3] Standard Atlas of Iroquois County, Illinois. (Chicago: George A. Ogle and Company, 1893, 1910); Plat Book of Livingston County, Illinois. (Rockford, Illinois: W.W. Hixson and Company, 193?); Mrs. Raymond Wallrich, conversation, June 8, 1995.

[4]Proceedings of the Iroquois County Board of Supervisors Meeting. (Pontiac) September 2, 1905; (IRAD, Illinois Regional Archives Depository, Illinois State University, Normal.)

[5]Winters, "Wallrich Bridge", p. 2

[6]Mendenhall's New Road Map of Illinois showing through Bicycle Routes. (Cincinnati: C.S. Mendenhall, 1902); Map showing Marked Through Routes in Illinois. (Illinois State Highway Department, February, 1917).

[7]Mansfield Merriman and Henry S. Jacoby, A Text-book on Roofs and Bridges, Part I, 6th ed. (New York, John Wiley and Sons, Inc., 1920), pp. 208ff.

[8]David A. Simmons, "Engineering and Enterprise, Early Metal Truss Bridges in Ohio", in Timeline. (Columbus, Ohio Historical Society, Feb.-Mar. 1985), p. 26ff.

[9]James L. Cooper, Iron Monuments to Distant Posterity (Indiana's Metal Bridges, 1870-1930). (DePauw University and others, 1987), pp. 52ff. The New York Department of Transportation inventory includes 20 bowstring trussses built between 1867 and 1922: T.D. Quinn, correspondence, June 26, 1996.

[10]Illinois Highway Commission Report. (Springfield: State of Illinois, 1906) pp. 55ff.

[11]Cooper, p. 53; Simmons, pp. 26ff.

[12]Illinois Department of Transportation, Historic Bridge Survey List. (Springfield: Bureau of Location and Environment, 1992), p. 3101m.2TP, 3101a.TP.

[13] Victor C. Darnell, Directory of American Bridge Building Companies, 1840-1898. (Washington D.C.: Society for Industrial Archaeology, 1984), pp. Introduction, 13; Simmons, pp. 26 ff; Cooper, p. 6ff.

[14] 1990 Calendar (New York: American Society of Civil Engineers, 1989), pp. Introduction, June.

[15] Ibid.

[16] Bridge and detail sketches, Boyer Engineering Ltd.; measurements by the author, June 8, 1995; Bridge rating sketch, Auby, Oglesby, Rebok and Bartolomucci, consultants, October 20, 1975, County files.

[17] County Engineering files, Repair Bill, G.A.S. Co., February 26, 1982.

[18] Winters, "Wallrich Bridge", p. 3; Herbert W. Ferris, Historical Record, Dimensions and Properties, Rolled Shapes (New York: American Institute of Steel Construction), p. 5; Richard O'Connor, Johnstown: The Day the Dam Broke (Philadelphia: Lippincott, 1957).

[19] Winters, conversation, May 31, 1996; Repair Contract, January 21, 1976, Livingston County bridge files.

[20] Winters, conversation, May 31, 1996; "Wallrich Bridge" report.

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F. Library Resources

Illinois State Historical Library
Old Capitol Square
Springfield, Illinois 62756
Telephone 217/524-6358
(Histories, newspaper microfilms)

G. Conversations

Kopp, Leslie
Collum Memorial Library
Collum, Illinois 62909
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Telephone 815/689-2495

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Telephone 518/457-4551
(Supplied bowstring data in New York State inventory)

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H. Schematic Sketch of Wallrich Bowstring Truss

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Report prepared by:
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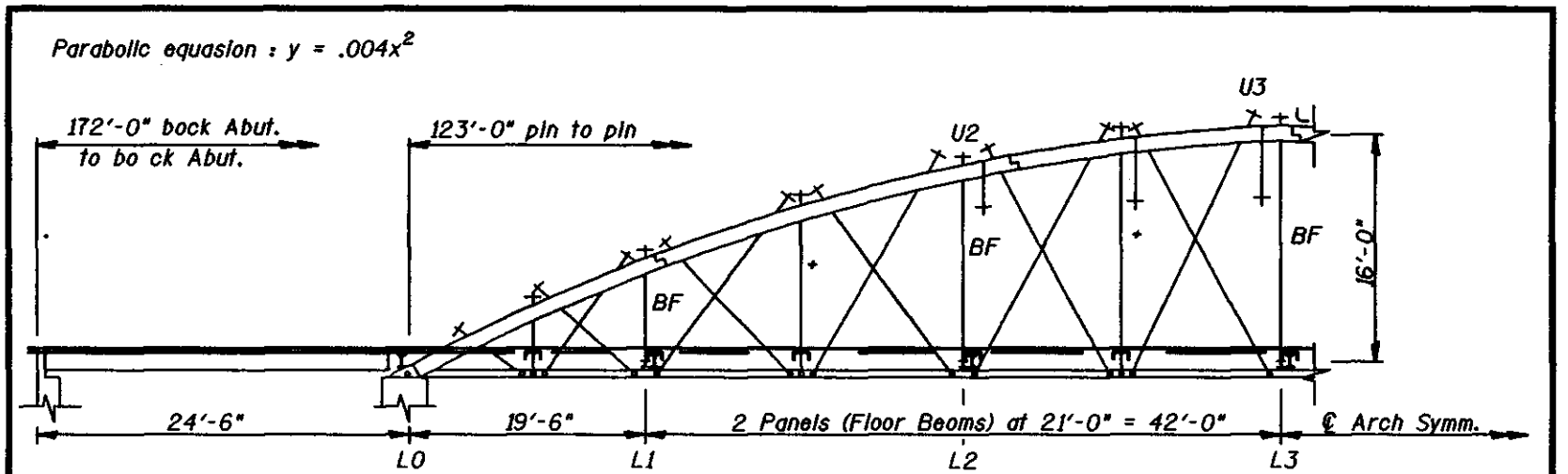
Telephone 217/529-1550

June 21, 1996



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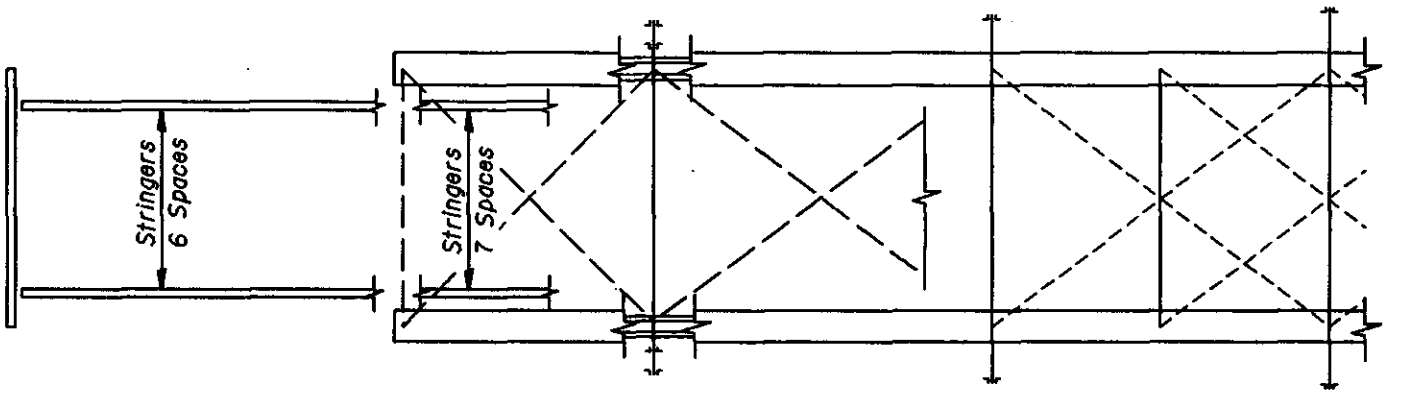


LOWER CROSS BRACING TOP ARCH & CROSS BRACING

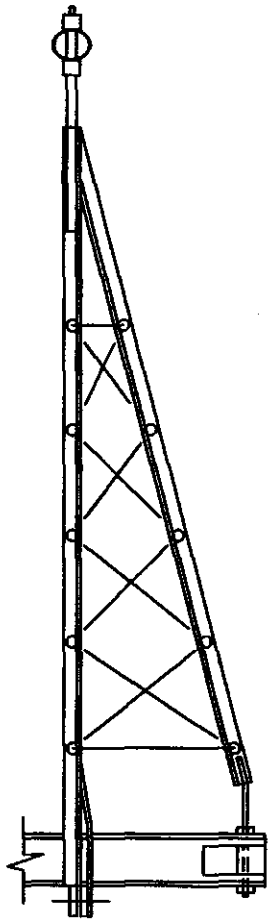
PARTIAL PLAN

BF = Brace Frame
+ = Crulcform Rod

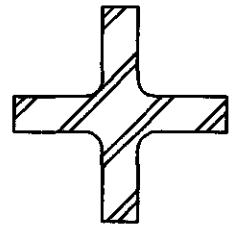
WALLRICH BRIDGE
HAER IL-132
NORTHFORK-VERMILLION RIVER
LIVINGSTON COUNTY, ILLINOIS
S.N. 053-3404

BOYER ENGINEERING LIMITED

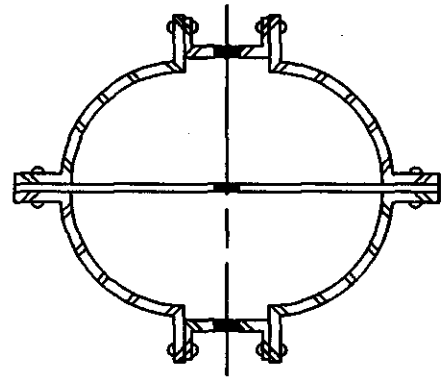
SHEET 1 OF 2



BRACE FRAME



CRUCIFORM RODS
(L1.5, L2.5, etc.)

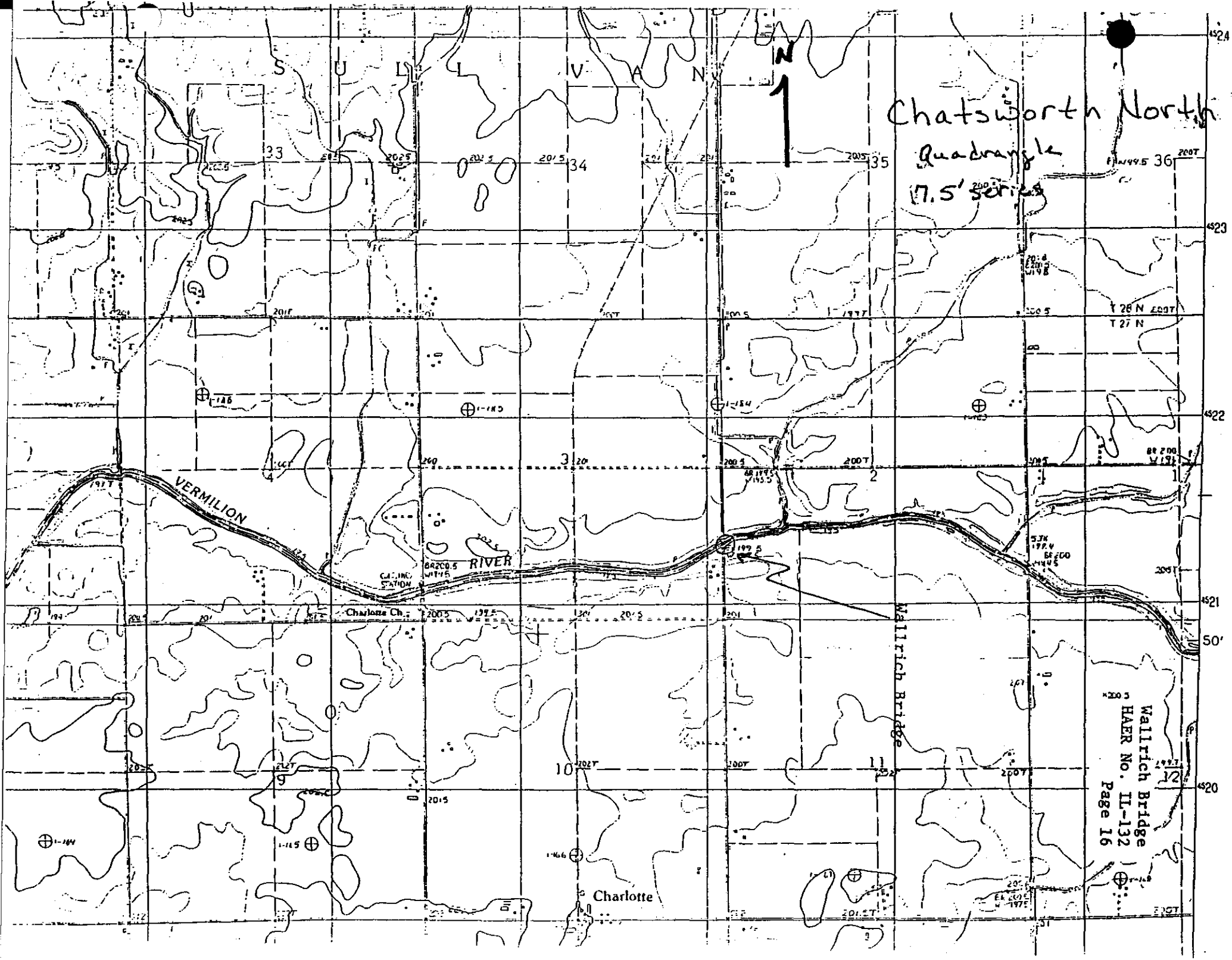


ARCH SECTION

WALLRICH BRIDGE
HAER IL-132
NORTHFORK-VERMILLION RIVER
LIVINGSTON COUNTY, ILLINOIS
S.N. 053-3404

SHEET 2 OF 2

BOYER ENGINEERING LIMITED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